LIFE CYCLE AND COMMUNITY STRUCTURE OF MAYFLIES (INSECTA: EPHEMEROPTERA) AND CHIRONOMIDS (INSECTA: CHIRONOMIDAE) IN THE NAVASOTA RIVER, TEXAS.

An Undergraduate Research Scholars Thesis

by

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Submitted to Honors and Undergraduate Research
Texas A&M University
in partial fulfillment of the requirements for the designation as an

UNDERGRADUATE RESEARCH SCHOLAR

Approved by
Research Advisor: Dr. David Baumgardner

May 2015

Major: Biology

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ABSTRACT

Life Cycle And Community Structure Of Mayflies (Insecta: Ephemeroptera) And Chironomids (Insecta: Chironomidae) In The Navasota River, Texas. (May 2015)

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Research focused upon the structure and function of low elevation, turbid lotic ecosystems is lacking throughout much of the southeastern United States. This lack of basic ecological data severely hampers decision makers involving management of freshwater resources. The Navasota River, a low elevation, turbid lotic ecosystem, originates in southeast Hill County (in east Texas) and flows approximately 125 miles south to join the Brazos River. Only limited data is available concerning the invertebrate communities and ecological functions these communities contribute to the Navasota River. The purpose of this study was to gain a better understanding of the life cycle and community structure of mayflies (Insecta: Ephemeroptera) and chironomids (Insecta: Diptera) in the Navasota River, near where it joins the Brazos River. Quantitative samples were obtained approximately every four weeks from August 2014 through July 2015. The majority of chironomids were represented by the subfamily Tanypodinae. However, it was not possible to determine species for a variety of reasons. Chironomids were most common from January through July, with relatively small numbers of individuals from August through December. Mayflies were most common in September and October. Most of the mayflies were determined to be from the genus *Beatis.*

CHAPTER I

INTRODUCTION

Lotic ecosystems have been used (and often abused) by humans for centuries. Rivers have been dammed and diverted for flood control and hydropower generation, and used for navigation (Benke and Cusing, 2011). They are also used as a source of water for agriculture, industry, and human consumption, and play a vital role in the economies of many communities. Although the past 35 years have seen a shift in society's attitudes toward rivers and the need to conserve these natural resources (Benke and Cusing, 2011), there still remain significant gaps in our knowledge of the structure and function of invertebrates that inhabit these ecosystems. The Navasota River is an example, with few published studies of aquatic insects living in the Navasota River. This lack of data makes it difficult to understand the structure and function of aquatic insects communities in the river, and also impedes a better understanding of how aquatic communities respond to changes in the river due to natural or anthropomorphic events. By studying the life history and community structure of mayflies (Ephemeroptera) and chironomids (Diptera: Chironomidae), a better understanding of the ecology of aquatic insects in the Navasota River will be developed. This data can be used to help gain a better understanding of the river, its inhabitants, and its ecological structure and function.

CHAPTER II

METHODS

Aquatic insects were collected approximately every four to six weeks (depending on river flow) from the Navasota River, 30 Km south of College Station, at the Highway 6 Bridge (Figure 1.) Upstream from the bridge is a shallow riffle that was the sample location for all of the collections (Figure 2.) During each collection four quantitative, replicate samples were taken of the benthos using a Hess Sampler (Figure 3) with a collection net size of 250 µm.

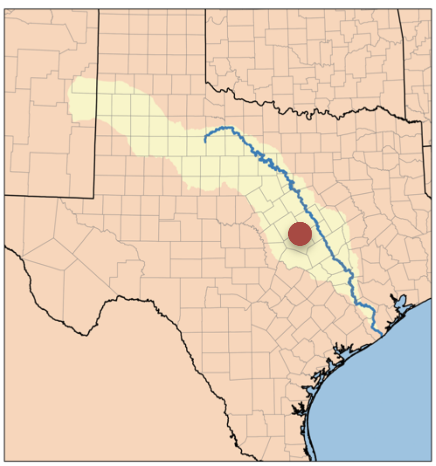

Figure 1 location of collection site

Figure 2 collection riffle

All aquatic macroinvertebrates within the Hess sampler were removed from large rocks and woody debris using a laboratory glass cleaning brush, while the substrate was disrupted down to about 3 cm using a True Temper ErgoLoop Garden Hand Weeder with Fulcrum (Figure 3). All macroinvertebrates were then placed in a 500 mL Nalgene bottle containing 75% ethyl alcohol for preservation and transport.

Upon returning to the laboratory, samples were sorted and all aquatic invertebrates were removed and stored in 4-dram glass vials labeled with collection date and location. An AM dissecting microscopes was used for sorting of all specimens. All mayflies and chironomids were removed for further analysis. An AM dissection microscope with a calibrated ocular micrometer was used to measure the head capsule width of each chironomid and mayfly, in

Figure 3 Hess Sampler

millimeters, and recorded in an Excel spreadsheet. The head capsule measurements were then graphed, with collection date along the x-axis and average head capsule width along the y-axis for both species. This provided a visual representation of growth of insects throughout the year. Additional analysis of the collected data will include analysis of sample variance between replicate samples, density measures, and taxonomic diversity throughout the year.

CHAPTER III

RESULTS

There is no data to report for the months of November 2013, December 2013 or May 2014. The collection site was flooded during November and December (figure 4), making collection impossible. During the month of mate all lab group members were at a conference in Oregon, pertaining to the study. For the rest of the study year data was collected regularly.

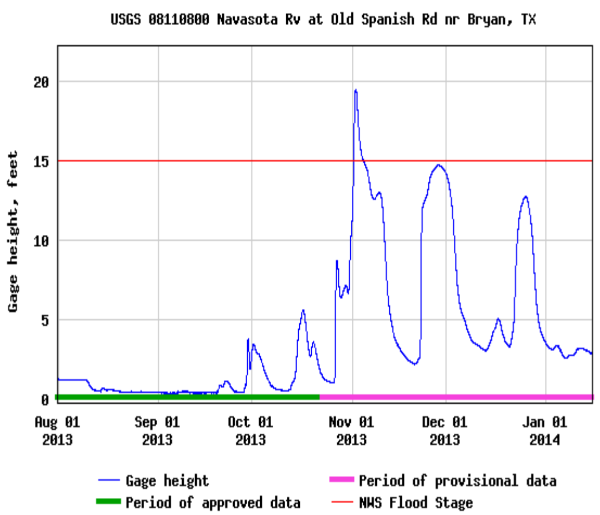

Figure 4 graph of flood information in Navasota River

Chironomidae

Interpreting chironomidae data is inherently difficult due to the complex nature of the taxonomy of the family. Unfortunately, individual specimens could not be identified beyond the taxonomic level of subfamily, making detailed assessments of species within the family nearly impossible. Population counts of chironomids did vary greatly throughout the study (figure 5). February and

April had the highest total number of individual samples, with 113 chironomids and 92, respectfully.

There was also extensive variation in head capsule width measurements in each month, ranging from 0.06mm to 0.14mm. This variation could be a result of several different species, multiple generations of one species, or more likely a combination of both.

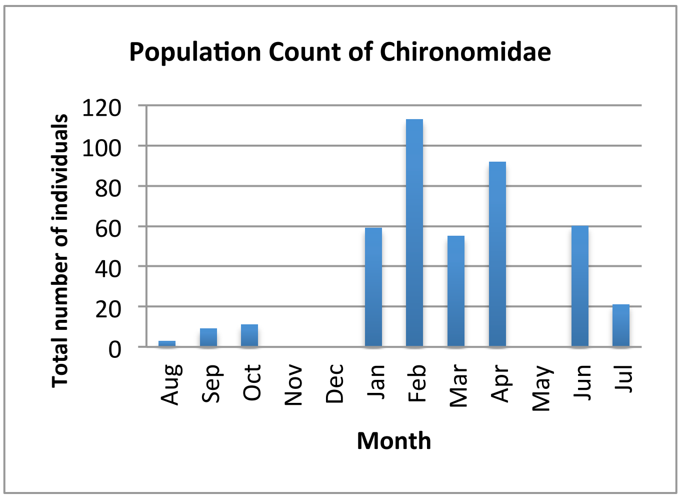

Figure 5 Population count of Chironomidae

Ephemeroptera

Individuals of the genus *Baetis* were the most commonly encountered individuals of mayflies.

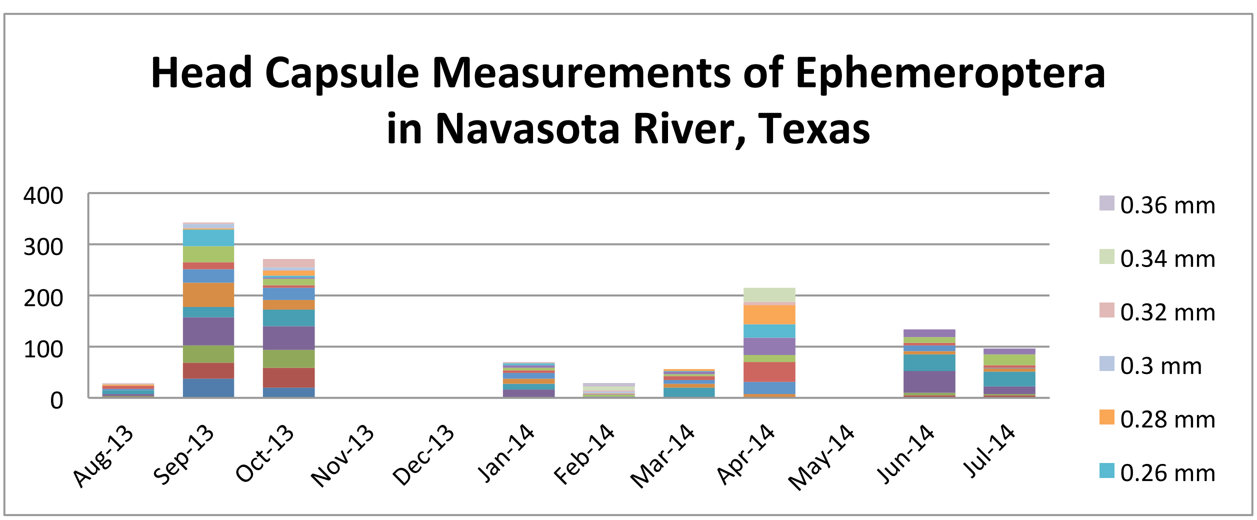

Figure 6 Head capsule measurements of Ephemeroptera

This is also a diverse and complex genus, with species identifications based on larvae often difficult, if not impossible. However, some information can be obtained from the samples. First, the greatest populations of mayflies were seen in the months of September and October, along with some of the largest larvae, indicating likely adult emergence. Second, based upon the head capsule measurements it is also evident that there are multiple instars present every month. As with the chironomids, it is not possible at this point to definitively understand detailed life history information on any of the species.

CHAPTER IV

CONCLUSIONS

Chironomidae

The majority of larvae studied were of the subfamily Tanypodinae, however, it is unclear how many species are present in the Navasota River due to the extensive diversity of the family and poor knowledge of the larval stage. It is also unclear as to why there were so few individuals collected in August through October and then a large increase in the number of individuals in January. The absence of data in November and December obscure the interpretation of results. However, it is likely that adults emerged in November or December, mated and laid eggs, which then hatched resulting in greatly in a large increase in the number of individuals. This conclusion is supported by the fact that there were many smaller larvae present in January.

In was observed that chironomids more common on woody debris than in riffles. The numbers of chironomids was much greater when a sample contained woody debris. Phillips (2003) researched the influence of habitat preference on macroinvertebrate density. According to Phillips, in freshwater streams there are differences in macroinvertebrate densities, as well as the different taxa having specific habitat preferences. This is emphasized with his discovery that, of the macroinvertebrates studied the chironomids showed the greatest density on macrophytes. From this study it was concluded that habitat preference influences stream colonization by macroinvertebrates, and by increasing habitat diversity the overall colonization could increase. The habitat preference of chironomids could lead to a better understanding of the life history of this species in the Navasota River. The extreme variation in data for the chironomids in the study of the Navasota River could be caused by a habitat preference of the species that was not accounted for during collection.

Chironomids are distributed throughout the world; their ranges extending from the far north to the Antarctic (Oliver, 1971). They are present in almost all aquatic habitats in this range including the estuaries of the oceans. The main requirement of the environment to support the chironomids is water that can support larval growth. It is most common in the species to have four larval instars. The instar stages are easily resolved by analysis of head capsule width. The majority of the species of chironomids build a larval case, on or in their substrate during the second larval instar (Oliver, 1971). This could be one possible explanation of the t variation found in the numbers of chironomids during certain months in data from the Navasota River. There is also the possibility that the chironomids in this community prefer a more specific habitat to the one we were studying. In some of the samples there was more woody debris and these samples seemed to have larger numbers of Chironomids. Further study and expanded collection techniques would be needed to verify these conclusions.

Ephemeroptera

The relatively warm, year around water may account for presence of mature mayfly larvae each month. January, February, and April appear to be peak months for emergence of adults. However the measurements of head capsule width were highly variable each month. This variance could indicate the presence of multiple species, overlapping generations. T sexual dimorphism, or differences in development based upon temperature or food availability.

Edmunds (1976) described the emergence patterns of mayflies in western United States. The mayflies in this study hatched from their eggs when the water was approximately 21°C and did not emerge from the water as adults until the fall when the water is cooler. The study suggests that at least some species in the US hatch in the summer and emerge as adults from the water in early fall. This is similar to the patterns observed for mayflies in the Navasota River.

A better and more complete understanding of the life histories and community structure of chironomids and mayflies in the Navasota River will involve more detailed and extensive research. Plans to continue this into the next year should focus on species identifications in order to better understand the role each species plays in the ecology of the Navasota River.

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